RESIDENTIAL SMOKE DETECTOR PROGRAM

DISTRIBUTION PRIORITIZATION AND EFFECTIVENESS MEASUREMENT

FIRE SERVICE FINANCIAL MANAGEMENT

BY: C. Hadden Culp, Jr.
Prince William County, Department of Fire and Rescue
Prince William County, Virginia

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ABSTRACT

Prince William County, and other regional departments, received smoke detectors from the Tandy Corporation for distribution. The problem was there are a limited number of free smoke detectors available and the *need* for smoke detectors varies between households. The purpose of this project was to identify prioritization indicators to reach community "target audiences," and to identify performance measurements to assess program effectiveness. Descriptive and evaluative research was used to answer the following questions: Are there citizen groups that need smoke detectors, and how do we identify them? What order should those targeted be approached? How can the department measure the effectiveness of a residential smoke detector installation program?

The procedures were to conduct a literature search on why smoke detectors typically do not work in residences, and to identify factors for residences least likely to have a working smoke detector. Additionally, the remaining nine regional departments were interviewed to determine if they had established a procedure to identify "target audiences."

The results of the research were generally "older" structures were more likely to need a smoke detector(s) than newer structures; lower income residences were more likely to need a smoke detector; and, occupants less than 5 years old and older than 65 years old die in fires at a rate disproportionate to the rest of the population. Also learned was some of the interviewed departments target portions of the groups mentioned above, while others target their entire community. Performance measurement was an area where most identified improvement could be made.

Recommendations from this research included (a) finding targeted groups through county databases, (b) compiling the information by "first due" area for installation order prioritization, (c) improve public education to help ensure smoke detector maintenance, and (d) linking the installation data to the incident reporting data for performance measurement documentation.

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INTRODUCTION

Prince William County Department of Fire and Rescue (PWCDFR) employs several life safety strategies to prevent and limit injuries and death to the citizens of Prince William County. One of these is to provide free smoke detectors to residents who cannot afford them. PWCDFR has been obtaining grants for the purchase of smoke detectors, and donations of smoke detectors for this program. However, limited resources require the organization to identify where best to apply the effort of the residential smoke detector installation program. Additionally, in order to identify if an impact is being made on fire deaths and injuries, the department needs the capability of evaluating the effectiveness of the residential smoke detector program.

The purpose of this project was to identify prioritization indicators for approaching the community, in a fashion that would reach the greatest number of "target audiences" as possible, and to identify a method for tracking department performance measurements following the implementation of the residential smoke detector installation program. Descriptive and evaluative research was used to answer the following questions:

1. Are there citizen groups or specific neighborhoods that need smoke detectors, and how do we identify them?
2. In what order should those targeted be approached?
3. How can the department measure the effectiveness of a residential smoke detector installation program?

BACKGROUND AND SIGNIFICANCE

Leadership of the Prince William County government identifies life safety prevention activity as a high priority and has developed strategies for the Chief of the Department to address in order to prevent injuries by accidents and reduce the likelihood of death by fire. Derived from extensive citizen input through the Prince William County Commission on the Future, the Prince William Board of County Supervisors established a Public Safety goal in the *1996-2000 Strategic Plan* stating, "The County will be a safe community, will reduce crime and prevent personal injury and loss of life and property (Prince William County, 1997, p. 20)." To emphasize the importance of the goal, the Board of County Supervisors also provided the "Desired outcome by FY 2001 [of] reduce[ing] fire injuries from 18.5/100,000 to 15/100,000 (Prince William County, 1997, p. 20)." To that end, the organization has several goals and objectives aimed at educating the public, and developing and enforcing fire prevention codes. In fact, Prince William County has a local ordinance requiring smoke detectors under certain circumstances (Appendix A). In 1997, PWCDFR took the aspect of the prevention program beyond code enforcement and education by installing smoke detectors using fire and rescue personnel. A donation of 500 smoke detectors by the Tandy Corporation provided free smoke detectors to PWCDFR for distribution to the community (in 1998 the donation increased to 1,000).

Several issues were identified relative to liability, installation procedures, and record keeping. The County Attorney provided guidelines to reduce the organization's exposure to liability, and a procedure was developed to help ensure standard application of the installation program. The smoke detectors were distributed to the fire and rescue stations. Limited, general

population marketing took place, and department personnel installed the smoke detectors as requested by individuals within the community.

Occasionally, individual fire and rescue companies within the Prince William County system would embark on a local neighborhood installation campaign, often following a serious fire in that area. During fire prevention activities in October 1998, many fire and rescue companies initiated local door-to-door campaigns to provide life safety education and, where needed, to install smoke detectors. However, target areas were loosely identified and the efforts were limited in scope and duration.

Missing from the program was a systematic approach towards ensuring that all citizens who needed smoke detectors had them, or, if citizens had smoke detectors, steps had been taken to ensure they worked. A townhouse fire on December 25, 1998 took the lives of six occupants and reinforced to our department that there was still work to be done in our community to prevent deaths and injuries. A smoke detector was not located in the basement where the fire started, and it's questionable as to whether the detectors located on the remaining two floors activated. Additionally, in January, 1999, an infant died in a crib fire where the house had a working smoke detector, however the smoke detector was located in the hallway and did not activate until the father opened the bedroom door and allowed enough smoke to reach the detector to activate it.

Following the December 1998 townhouse fire, a localized neighborhood door-to-door education and smoke detector installation campaign took place. Of the 47 houses visited 15% had dead or missing smoke detectors (the houses were built in the early 1970's). A new problem was discovered during this effort: three houses had AC powered smoke detectors that, even though they had power, the smoke detectors did not operate when the test button was pushed.

This caused concern that even if smoke detectors were present, would they operate? Based on these issues in the Prince William County community, a method was needed to identify those citizens or neighborhoods where smoke detectors might not have ever been installed, or "not enough smoke detectors were installed," or that the ones installed worked correctly. Additionally, a process for determining the effectiveness of an organizational effort needed to be identified.

The planing process in the National Fire Academy *Fire Service Financial Management* (1997) course emphasizes that the efficiency of organizational services are measured through service outputs, and then the organization can best identify if it is achieving the outcomes or effectiveness of service delivery being provided to the community. As an organization works through the "transformation process" of budget development, a cycle is established showing the links between resources (people, time, money), service (outputs) outcomes, and feedback. In order to justify resources for a smoke detector installation program, service outputs and impacts on organizational outcomes need to be identified.

The current PWCDFR residential smoke detector installation program lacks focus and the following questions need to be answered: Are we checking houses that are less likely to need a smoke detector than others? Are there citizens or entire neighborhoods more likely in need of a smoke detector than others? Our program lacks direction: Are personnel clear on which areas of our community need to be approached before others to have a greater impact on injuries and deaths associated having smoke detector presence and performance? Is there a system for providing data collection and feedback to the fire and rescue personnel, the Chief, the budget office, and the community to identify if the time, money, and effort associated with this type of activity are having an impact on deaths and injuries? And finally, have other departments

identified methods of analyzing the need for smoke detectors, implemented a program, and measured the impact? The intent of this study is to identify methods to improve our smoke detector program and to justify it's existence.

LITERATURE REVIEW

The Literature Review was conducted utilizing a variety of resources. The foremost was the Learning Resource Center at the National Fire Academy, along with the United States Fire Administration, National Fire Data Center and the National Fire Protection Association. Additional information was obtained from the Federal Government and Universities via the Internet.

Confirmation of the Problem

There is little dispute in the literature regarding the need for properly installed and maintained smoke detectors. In a review of nationwide data, for the time period 1991-1995, Hall (1998) identified that "Overall, 58 percent of civilian fatalities occurred in home fires where no detector was present" (p. 29). Hall further identified that, "Even though 92 percent of homes in the U. S. were equipped with detectors in 1993 (the middle year of the period used for analysis here), 45 percent of home fires occurred in homes without detectors" (p. 32). Additionally, in a smoke alarm study conducted in the United States, Ahrens (1998) found that, "Most homes have smoke alarms, but 42% of reported home fires and 59% of home fire deaths occur in homes with no smoke alarm" (p. i). Ahrens concludes, "Homes with smoke alarms (without specifying operational status) typically have a death rate about 40-50% less than the rate of homes without alarms" (p. i).

Why aren't smoke detectors sounding the alarm?

In 1992, the Consumer Product Safety Commission (CPSC) sponsored a *Smoke Detector Operability Survey* to identify data relative to smoke detector types, use, and performance. The findings of the survey identified "…an estimated 28 percent of households were without a working smoke detector….[and that] At least 26 percent of households with smoke detectors did not have enough detectors to meet the requirement of every-level-protection endorsed by fire services" (Smith, 1993, p. i). Additionally, Smith (1993) found "A high percentage of inoperative smoke detectors in households had dead batteries, or missing or disconnected batteries or AC power sources" (p. 24). Of those not working, "Almost 93 percent of detectors observed to have problems with power sources were powered by batteries only" (Smith, 1998, p. ii). Another significant contribution made by the Smith's (1993) survey is:

> Residences that were built more recently were much more likely to have smoke detectors powered by AC, including AC powered detectors with a battery backup, than were older residences. Nearly 70 percent of smoke detectors in residences built from 1980 through 1992 were AC powered, compared to about 30 percent of the detectors found in residences built in the 1970's, and fewer than 20 percent of detectors in residences built before 1970 (p. 15).

In another study where fatalities in residential fire was the outcome measured and the intervention observed was the presence of a smoke detector a 71% "protective effect" was realized due to smoke detectors (Runyan et al.) (Harborview Injury Prevention and Research Center [HIPRC]) (1997b). HIPRC also identified "those at greatest risk are children under 5 and the elderly….Other risk factors for residential fires are alcohol, drug and cigarette use,

substandard heating (space heaters both electrical and kerosene types) and substandard electrical wiring."

Ahrens (1998) identifies how the age of a smoke detector can have an impact on its operation. Ahrens compares smoke detectors to other household appliances like toasters, stereos, and furnaces that can, and do, wear out. "Roughly half of the smoke alarms collected as inoperable and studied in the *National Smoke Detector Project* were more than 10 years old, hence older than the currently recommended replacement age" (Ahrens, 1998, p. 22).

Approaching the Community

McKnight, Struttman, and Mays (1995) found "the most objective method of collecting data on smoke detectors is to inspect homes for placement and functioning of smoke detectors" (p. 550). In determining the need for smoke detectors, if asked, "respondents may assume that their smoke detectors work when in fact they do not" (McNight et al. 1995, p. 553). Additionally, McNight et al. found that "Perhaps some respondents thought it was socially desirable to claim that they had a smoke detector, even if they had none" (p. 553).

Smith (1994) provided data on the operability of observed detectors and made a comparison to annual household income (p. 20). With few exceptions, there doesn't seem to be any correlation between household income and the conditions noted that would effect the operation of a smoke detector. Two areas where those with lower incomes were noted to have disproportionate ratios of smoke detector performance resulted from "insects and cobwebs", and "alarms continuously" (Smith, 1994). "Higher death and injury rates in lower socio-economic census tracts are in part due to poor quality housing (Baker)" (HIPRC, 1997b). Further, in a study on interventions to increase smoke detector use the HIPRC (1997a) concluded, "…Homes that need protection the most (low income dwellings) are least likely to have smoke detectors."

> Additionally, regarding the ages of those dying in fires, Hall (1998) concludes: Preschool children (age 5 and under) and older adults (age 65 and over) accounted for a disproportionate number of fire deaths in homes. Home fire death rates were roughly twice the national average for adults age 65 and older, nearly three times the national average for adults 75 and older, and more than four times the national average for adults 85 and older. Preschool children died at a rate more than two and one-third times the national average (p. i).

Some organizations have aggressive fire prevention programs to educate the public, building codes requiring protection systems (like smoke detectors), and local laws or ordinances requiring smoke detectors, and they are still not satisfied with the results. After several fire deaths, the Hampton, Va. Fire Department elected to enhance fire prevention activities and approach its 48,000 residences through a door-to-door campaign. They distributed literature and installed smoke detectors, as needed. Between April, 1997 and February, 1998 there had been at least two fires where the occupants were alerted to the danger by the smoke detectors the department had installed (Cade, 1998, p. 65).

Program Measurement

Linking the prevention program to department performance helps to justify the expenditure. Documentation of "lives saved" enabled the Hampton Fire Department to validate the costs associated with their program. Worthy to also note were the spin-off benefits achieved such as improved community perception of the department and employee interest in public education efforts (Cade, 1998, p. 66). The Baltimore Fire Department realized a 33% drop in fire losses following an aggressive public awareness campaign that included the installation of

35,000 smoke detectors (Torres, 1997, p. 152). In his EFO paper on *Smoke Detectors In The Home,* Smith (1992) refers to Montgomery Co. Maryland's 62% reduction in fire deaths since the adoption of smoke detector legislation (Marchone)" (p. 7). Additionally, in a statewide smoke detector program, South Carolina interrupted a "20-percent-per-year" increase in the state's fire death rate (Perroni, 1990, p. 7).

The Workforce Development Performance Measures Initiative (WDPMI) (1998) identifies that there are "four distinct aspects of performance measurement: outcomes, efficiency, customer focus and continuous improvement" (p. 1). The WDPMI provides several Guiding Principles (Appendix B) in developing measures for organizational activities. Performance characteristics should include that the measures are system focused, limited, understandable reliable, valid and informative.

Having measurable items relative to program performance allows for comparison of programs, goal development, and progress identification. McKnight et al. (1995) referenced a "United States year 2000 goal of no more than 1.2 residential fire deaths per 100,000 population (Public Health Service)" (p. 549). Using 1997 data, Karter (1998) identifies that the Fire Loss Rate Nationwide is 15.2 per million (1.52 per 100,000) (p. 81). Performance measurement enables department's to study and understand the "distribution patterns" of services and programs, and to assess the impact being made on the community (National Fire Academy, 1997).

PROCEDURES

Research Methodology

The desired outcome of the research was to create a process for evaluating where best to apply staffing resources and available smoke detectors for installation in the community. Additionally, to determine if there was a way to measure the effectiveness of smoke detector installation intervention in a community. The literature search provided the documentation to support the need for a smoke detector installation program. Descriptive research was used to identify if other departments have smoke detector installation programs and if so, the details of those programs. Of particular interest was the method for assessing the need within the community and if there was any measurement of the impact on the local death and injury rate due to fire.

Assumptions and Limitations

PWCDFR, along with nine other departments in the Washington Metropolitan Region participated in a smoke detector give-away program that is part of a national program called "Operation FireSafe." The program began in the region in 1995. The program is a partnership between the Washington Metropolitan Region, Council of Governments (COG), the Tandy Corporation (Radio Shack), and a local television station (WUSA-TV). In October, 1998, participating departments, listed in Appendix C, received free smoke detectors (about 1,000 each) from Radio Shack. Not all COG member departments participate in the program each year.

I assumed that because the organizations participated in the Tandy Corporation's smoke detector give-away, that their department would have a process for smoke detector distribution to

the community. I elected to contact the participating departments to see how they had developed their community distribution plans, and if they had developed a method of measuring the performance of their programs. To obtain the information needed for this research, and to have the capability to expand on lessons learned by other departments, I elected to speak with each participating department directly. An in-depth interview was developed (Appendix D) and the public education office of each participating department was contacted.

To facilitate gathering specific information about programs, closed-ended questions were used. These questions were typically followed by an open-ended question to gather additional information specific to that departments individual program. In developing the interview questions, I first wanted to know if the locality had determined if there was a *specific* target audience in their community identified to receive smoke detectors in order to lessen exposure to injuries and death from fire. If a specific target group was identified, I asked how that target group was determined. Also, if more than one target group was identified, was there any process of prioritization? Regardless of whether or not there was a target group identified, I went on to inquire if they had a residential smoke detector program, and the details of how it worked. While I had the attention and focus of my public education peers, I took the opportunity to ask them other logistical questions about their program to facilitate other improvements in our program, not associated with this paper. These questions were on topics like installation procedures, other sources of funding, legal aspects, and the use of other organizations to install the detectors.

I asked the participants if they track the installation of the smoke detectors and if they ever conduct any follow-up contact with the citizen to ensure the effectiveness of the installation program. Additionally, the participants were asked if their departments identified any specific

performance measurements relative to the smoke detector program and if they link those measurements to their organizational effectiveness.

RESULTS

Information Obtained Relative to the Research Questions

Research Question One. In determining if there were specific neighborhoods that needed smoke detectors, I found that in some cases organizations had identified this need and targeted those groups. Some organizations focused on members of the community who were particularly young or old, or had a low financial income. However, the identification criterion was either generalized or vague. In one case, marketing efforts and public education programs aimed at target audiences were intended to initiate the request for a smoke detector installation. In another case, the determination of "old houses" and lower income families was left up to the local fire and rescue company to identify. Four organizations had targeted their entire community. Three jurisdictions targeted every house and visited each by first due response area. Another participant is a military installation providing protection to family housing "on-base." At the military base, newcomers get a briefing and detectors are installed by maintenance people as needed. In two cases, the age of the dwelling was identified as target criteria. However, again the limits of the definition were not specified. Two department's did not identify a particular target and either left the installation up to the local fire and rescue company, or provided installations as requested.

Research Question Two. To determine if there was an order for approaching targeted houses, in one case a jurisdiction attempted to target "older homes first" followed by lower

income houses. Another jurisdiction provided smoke detectors to "lower income houses" and "senior housing." Telephone *hot lines* were available in some cases for citizens to leave a request for a smoke detector installation. A typical scenario was that the message was forwarded to the nearest fire and rescue company for installation. In some cases the detectors were provided to the citizen for installation. Some jurisdictions conducted neighborhood installation campaigns following fatal fires and some routinely carried smoke detectors on fire and rescue apparatus for installation as identified as needed on routine calls. One department provides a smoke detector installation coupon in "new baby welcome baskets" given to families of newborn children at local hospitals. The department stipulates that the smoke detector *must* be installed in the infant's bedroom. They also contact the family on the child's first birthday and offer to replace the battery as a birthday present.

In almost all cases, those interviewed identified that no one who requested a smoke detector was denied a smoke detector installation even if they fell outside of any established target criteria. One jurisdiction had targeted low socioeconomic areas however, they discovered that loss data was beginning to show that efforts needed to be increased in the mid and upper income areas of the community as well.

Research Question Three. While most departments collected installation data (address, date, liability waiver, etc.), few actually track any life saving or injury prevention statistics based on their smoke detector installation program. One department attributed two "saves" to the program, and another identified that the statistics obtained (i.e.: number of smoke detectors installed per year) was helpful during public education program budget justifications. In some

cases collection of data from those conducting the installations was identified as an area needing improvement to enhance statistical analysis.

Unexpected Findings

Additional information was discovered in the interviews that are worthy to include and is listed in Appendix E.

DISCUSSION

In comparison of the interview findings and those of the literature search, the *intent* of the smoke detector give-away programs coincides with the needs of the community. HIPRC (1997a) concludes "Smoke detector give away programs have proven successful when high risk areas are targeted (Mallone,Viscusi)." Just as Hall (1998) identifies that the young and the elderly account for a disproportionate number of fire deaths in homes, some of the interviewed organizations attempted to target those individuals in their installation programs. Additionally, several departments targeted households with "low-income" even though no specific identifiable criteria were established. However, data provided by Smith (1994) indicates that there does not appear to be a disproportionate ratio in smoke detector operation *based on household income.* McKnight et al. (1995) does however include low household income as one of the four characteristics strongly associated with absence of a working smoke detector.

One area mentioned by two of the departments interviewed is targeting residential structures based on the age of the building. Following an extensive study on finding homes without smoke detectors, McNight et al. (1995) concluded that the age of the dwelling was an additional opportunity for study on smoke detector operability. Additionally, Smith (1994) identified that there was a 40% increase in residences with AC powered smoke detectors (over

battery powered) in the time period 1980 to 1992 as compared to the 1970's. Smith's study provides the likely attribution of the increase in AC powered smoke detectors to revisions to building codes in recent years. Smith also identified in the *Smoke Detector Operability Survey* that "Almost 93 percent of detectors observed to have problems with power sources were powered by batteries only" (p.ii). Those departments targeting older dwellings for smoke detector installations may be finding dwellings without AC powered smoke detectors and therein increasing the likelihood of replacing or repairing (dead battery) an inoperable battery powered smoke detector. Therefore, the more of the following criteria residences meet the greater the likelihood that a smoke detector is needed, and that targeting these groups would reduce death and injuries from fire:

- Older dwelling's (built before 1970, 1980, 1990, etc.)
- Households with low-income (< $15,000 annual income)
- Households with younger (< 5 yrs.) or older (> 65 yrs.) occupants

Those departments who combined educational efforts with their smoke detector installation programs improve the likelihood of preventing injuries and saving lives. HIPRC (1997a) noted in its summary of interventions to increase smoke detector use that "The successful programs have one specific goal, installation of smoke detectors and used multi-faceted community campaigns."

Some departments noted the benefit in measuring the number of smoke detectors installed and identifying lives saved that can be attributed to the smoke detectors installed by a department. HIPRC (1997a) identified several outcomes that organizations have used in assessing the impact of interventions to increase smoke detector use. Appendix F lists HIPRC's

(1997a) table showing the outcomes and results of various department interventions. Of interest to note is the variety of criterion used in defining the performance measurements.

The implication of the study is that lives are saved and injuries reduced through targeted application of residential smoke detectors. However, improved record keeping capability is needed to facilitate cross-referencing of smoke detector installation data with Fire Incident Reporting performance data. Additionally, organizations need to improve methods for the identification of target groups.

RECOMMENDATIONS

Finding dwellings that are older, have occupants with lower incomes, and younger and/or older occupant ages will increase the likelihood that a smoke detector is needed. Targeting these groups would lessen the numbers of those most likely not to have a smoke detector. The first group to target is the older residential dwellings. The County Real Estate database can provide age information on dwellings. Dwelling date "breakpoints" would be: (a) pre 1978 (this is the date when the local building code began requiring smoke detectors), (b) 1978 to 1988 (due to smoke detectors greater than 10 years old being recommended for replacement, (c) 1989 to 1994 and then (d) 1995 to present. Secondly, other County agencies could be consulted to determine if resident age and income could be identified and linked to the dwelling age information. Once the information is compiled, this information could be sorted for smoke detector distribution by "first due" areas. Fire and Rescue companies are already trained and accustomed to installing smoke detectors. Procedures for installation and distribution are already in place.

HIPRC (1997a) identifies "Two barriers to effective use of smoke detectors are proper installation and maintenance and the reluctance of renters to purchase the devices

(Runyan,Miller)." Additionally, improvement is needed in educational information provided to help ensure the occupant understands on-going smoke detector maintenance responsibilities as well as other life safety information. Providing "replace your battery reminder stickers" for residents to put on their calendar has proven successful in other programs. In Prince William County, the Fire Marshals Office could provide additional support to renters in dealing with landlords who don't provide smoke detectors.

A system for linking the installation data with local Fire Incident Reporting data is needed to track the effectiveness of the program. This information would allow for a direct comparison between injuries from fire or lives saved in relation to detectors installed. Recommended annual performance measures, in Prince William County, are:

- Fire deaths per 100,000 population
- Smoke detectors installed per year
- Smoke detectors installed per number of fire deaths
- Alarms (due to fire) at occupancy's with department installed smoke detector
- Lives saved due to department installed smoke detector(s)
- Alarms (due to fire) at occupancy with smoke detector
- Lives saved due to smoke detector(s)

Information gathered would be useful in the "judgement of [a] fire [and rescue] department's performance in the production, delivery, and consequence[s] of its programs and services" (National Fire Academy, 1997, p. SM 4-15).

Other areas of research would include assessing the issues associated with replacing non-working AC powered smoke detectors with AC powered (preferably with battery backup) smoke

detectors. Also an area in need of further research is approaching Radio Shack to provide the 10 year lithium battery powered smoke detectors, and to determine the best method for reminding and ensuring that the detectors installed continue to work six months, one year, etc. after installed.

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APPENDIX A, LOCAL SMOKE DETECTOR ORDINANCE

ARTICLE V. SMOKE DETECTORS*

Sec. 5-80. Authority.

This article has been enacted pursuant to § 15.1-29.9 Code of Virginia (1981, C. 324). (No. 84-342, 4-24-84)

Sec. 5-81. Definitions.

As used in the article, the following words shall have the meanings herein ascribed to them, respectively:

Dwelling unit shall mean a single unit providing complete independent living facilities for one (1) or more persons, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

Owner shall mean one (1) or more persons, jointly or severally, in whom is vested:

(1) All or part of the legal title to the property; or

(2) All or part of the beneficial ownership and a right to present use and enjoyment of the premises, and the term includes a mortgagee in possession.

Smoke detectors shall mean mechanical devices, powered by batteries or alternating current, capable of sensing visible or invisible products of combustion that sound an audible alarm. (No. 84-342, 4-24-84)

Sec. 5-82. Where required.

Smoke detectors shall be required in the following structures:

(a) Buildings containing one (1) or more dwelling units; provided, however, any building containing fewer than four (4) dwelling units which was not in compliance with this article on July 1, 1984, shall be exempted from the requirements of this article until such time as that building or any dwelling unit therein is sold or rented to another person.

(b) Hotels or motels regularly used, offered for, or intended to be used to provide overnight sleeping accommodations for one (1) or more persons.

(c) Rooming houses regularly used, offered for, or intended to be used to provide overnight sleeping accommodations. (No. 84-342, 4-24-84; 84-613, 7-17-84)

Sec. 5-83. Installation requirements.

(a) Smoke detectors installed shall be capable of sensing visible or invisible products of combustion and providing a suitable alarm to awaken the occupants of a dwelling unit.

(b) Smoke detectors shall be installed in locations specified in the applicable section of the Virginia Uniform Statewide Building Code.

(c) Appropriate permits as required must be secured for the installation of the smoke detectors powered by alternating current. (No. 84-342, 4-24-84)

Sec. 5-84. Responsibilities.

(a) The owner or agent of the owner of a residential building containing one (1) or more dwelling units shall provide smoke detectors as required by section 5-83(b) and shall maintain them in good working order.

(b) The owner or agent of the owner of a dwelling unit, which, is rented or leased in a residential building containing one (1) or more dwelling units, shall furnish the tenant at the beginning of each tenancy, and at least annually thereafter, with written certification that all smoke detectors required by section 5-83(b) are present, have been inspected, and are in good working order.

(c) Except for smoke detectors located in hallways, stairwells, and other public or common areas of buildings, containing one (1) or more dwelling units, the tenant in rented or leased buildings shall be responsible for reasonable care of the smoke detector in accordance with § 55-248.16, Code of Virginia, and for interim testing and for providing written notice to the owner for repair of any malfunctioning smoke detector. In accordance with § 55-248.13, Code of Virginia, the owner shall be obligated to provide and pay for service, repair or replacement of any malfunctioning smoke detector within five (5) days of receipt of written notice from the tenant that a smoke detector is in need of repair.

(d) The owner or agent of the owner of a dwelling unit, which is rented or leased in a building containing one (1) or more dwelling units, shall provide written notification to the tenant of the responsibilities and duties imposed by subsection (c) of this section.

(e) The owner or agent of the owner shall notify, in writing, the office of the fire marshal, annually, that:

(1) All smoke detectors are still in place as required.

(2) All smoke detectors have been inspected and are in good working order.

(3) All tenants have been informed in writing of their responsibilities and duties as imposed by subsection (c) of this section.

(4) All tenants have received written classification as to the presence, inspection, and working condition of smoke detector(s) in their dwelling unit. (No. 84-342, 4-24-84; No. 84-613, 7-17-84)

Sec. 5-85. Enforcement.

The fire marshal or his duly authorized representative is authorized to administer and enforce this article. (No. 84-342, 4-24-84)

Sec. 5-86. Article not deemed exemption from compliance with building code.

Nothing in this article shall excuse any owner of the required buildings from compliance with all other applicable provisions of the Virginia Uniform Statewide Building Code. (No. 84-342, 4-24-84)

Sec. 5-87. Penalty for violations.

A violation of this article shall constitute a misdemeanor, punishable by a fine of not more than one thousand dollars ($1,000.00). Each day that a violation continues shall be deemed a separate offense. (No. 84-342, 4-24-84)

Secs. 5-88--5-90. Reserved.

APPENDIX B, GUIDING PRINCIPLES

System-focused. Performance measures assess progress toward achieving goals and objectives for the nation's workforce development system.

Consistent with GPRA. Performance measures are consistent with the basic tenets of the Government Performance and Results Act.

Limited. The number of performance measures is limited to focus on the most important indicators of success and to avoid diluting the influence of individual measures.

Understandable. Performance measures are simple, straight-forward and as easy to understand as possible.

Avoid Unintended Consequences. To the extent possible, performance measures avoid unintended consequences.

Cost Effective. Performance measures justify the cost of collecting and retaining data.

Efficient. To the extent possible, performance measures are streamlined to utilize existing data sources, reduce data collection burdens, and avoid asking for information that can be obtained from another source.

Reliable. Performance measures are reliable so that when the same measure is used in the same circumstances, it will obtain the same results.

Valid. Performance measures are valid so that they actually measure what they are supposed to be measuring rather than something else.

Informative (to program managers). Performance measures provide information to program managers in a timely manner and emphasize aspects of performance that are under management control.

Informative (to decision makers). Performance measures inform evaluative, planning, and policy decisions.

Clear. Workforce development service delivery staff are able to see a clear link between what they do and how performance is measured.

Understandable. A customer is able to understand why each element of data is collected and see the value of sharing that information.

Continuous Improvement. Performance measures promote continuous improvement.

APPENDIX C, PARTICIPATING DEPARTMENTS

District of Columbia

City of Alexandria, VA

Arlington County, VA

City of Fairfax, VA

Fairfax County, VA

Prince William County, VA

Frederick County, MD

Montgomery County, MD

Prince George's County, MD

Naval District of Washington

APPENDIX D, SMOKE DETECTOR SURVEY

1. Has your department identified a portion of your community where smoke detector installations could lessen citizen's exposure to injuries and death from fire? If no, please proceed to question 5. ❑ Yes
2. If yes, how was this target group determined?

_____

_____

3. If more than one group was identified, did your organization prioritize providing smoke detectors? How?

_____

_____

4. If yes, what is the order of prioritization?

_____

_____

5. Does your department have a residential smoke detector installation program? If no, please proceed to item 17. ❑ Yes
6. If yes, how does the program work?

_____

_____

_____

7. Does your department provide the smoke detector? ❑ Yes. If no, where do they come from? _____

   If yes, How does your organization obtain smoke detectors?

   - ❑ Donations?
   - ❑ Budget and appropriations?
   - ❑ Grants?

   ❑ Other _____

8. If your organization installs the smoke detector(s), specifically, who puts them up?

_____

9. If your organization does not install the smoke detectors, who does?

_____

10. How is the number of smoke detectors installed in a house determined?

_____

_____

11. What if there is a smoke detector present and it only needs a battery?

_____

_____

12. Does your organization have any policies or procedures relative to this topic? ❑ Yes

    If yes, please mail them to me.

13. Do you track the installation of smoke detectors? ❑ Yes

14. If yes, what information do you keep?

_____

_____

15. Has your organization identified any specific performance measurements (outputs) relative to smoke detector installations (ex.: the number of smoke detectors installed per year)? If yes, please list them:

_____

_____

16. Does your organization compare these outputs to organizational effectiveness (outcomes) (ex.: number of deaths per 100,00 per year)? If yes, please list them:

_____

_____

_____

17. If you have any data compiled on the effectiveness of your residential smoke detector program, I would appreciate a copy. Also, if you have any other information relative to a residential smoke detector program, or know of someone who has a program of this type, please let me know.

_____

_____

If you would like a copy of my project when completed, please check here. ❑

NAME: _____

TITLE: _____

DEPARTMENT: _____

ADDRESS: _____

_____

PHONE: _____

FAX: _____

E-MAIL: _____DATE:_____

APPENDIX E, "UNEXPECTED" FINDINGS

- The smoke detectors provided by Radio Shack are powered by 9-volt batteries. One department subsidizes the program with 10-year lithium battery powered detectors to those with special needs (i.e.: sight impaired), who call regularly for battery replacement.
- Some organizations augment Radio Shack smoke detector donations with smoke detector contributions from other businesses.
- Some organizations also provide special detectors for hearing impaired citizens. Funding for these detectors is either locally budgeted or provided through civic association donations.
- Unfortunately, no organization interviewed offered a *consistent* maintenance program to ensure that all the detector's installed, or provided by the organization, continued to function as intended; other than by information provided through on-going public education. One exception was the military base reserved the capability to inspect any housing unit for smoke detector operability, *if it so desired.* Another limited exception was the one-year follow-up conducted to families requesting a smoke detector through the "new baby program."

APPENDIX F, REVIEW OF STUDIES EVALUATING PROGRAMS TO INCREASE SMOKE DETECTOR USE

Authors	Study design and target population	Intervention	Outcomes	Results	Study quality and conclusions
Mallonee et al., 1996	Non-equivalent control group design The section of Oklahoma City with the highest rate of residential fires.	Smoke alarm give-away program combined with education and publicity campaign. Surveillance data used to target area with highest risk.	Deaths and injuries from burns in residential fires; injuries per 100,000 population and injury rate per 100 fires in Oklahoma City; comparing the south central section to the rest of the city. Number of operational smoke detectors 4 years post intervention	80% decrease in annualized injury rate per 100,000 population (from 15.3 to 3.1; incidence-density ratio 0.20 (0.10-0.40) compared to an 8% increase in the rest of the city (from 3.6 to 3.9; incidence density ratio 1.10 (0.70-1.7). Annual rate of fires per 1000 homes decreased 25% in target area and 18% in rest of city. Home inspection found 45% of smoke detectors functioning 4 years later.	Well-designed and executed study used surveillance data to target intervention area. Analyzed 3 years of burn incidence data prior to intervention and 4 years post intervention to stabilize rates. Temporal variation minimized by analyzing injuries per fire and per population. Suggests that a portion of the decrease in injuries is due to campaign education and publicity. Smoke detector give-away is an effective strategy to decrease fire-related injuries in high rate areas.
Gorman et al., 1985	Before/after design Baltimore, MD, city census tracts at high risk for fires	Smoke detector give-away program. Free smoke detectors given to citizens who called to request them (n=3720).	Installation and proper functioning of smoke detector Risk status of population reached via random sample of home visits (n=231) and in-person interview. 82.5% response rate from random home visits.	81% of homes inspected had installed and functioning smoke detectors. High-risk population reached. Linear correlation between the likelihood of receiving a smoke detector and the prior rate of fire injury and death (r=0.90, p<.001).	Successful smoke detector give-away program required active participation of a high risk population. Total program provided 110,000 smoke detectors to Baltimore households. (sold at cost and given away)
McLoughlin et al., 1985	Non equivalent control group design 2 affluent	Legislation-1978 required retrofitting of smoke detectors in	Homes with working smoke detectors. Compliance with building code as	Higher percentage of working detectors in intervention county (83% vs. 70%),	Evaluation in 1983. Unenforced law obeyed because it conforms to community values. Authors believe penalties

	suburban counties: Montgomery County, Maryland (MC) and Fairfax county, Virginia (FC).	all homes, (MC) vs. only new construction (FC).	judged by home visits	OR=2.1 1.01-4.34. Similar compliance with code in MC (42%) vs. FC (44%). Only 6% of intervention homes were without detectors vs.16% for control community.	attached to the law increased compliance. These are low risk communities. Study limited to single family homes which limits generalizability.
Miller, 1982	Non-equivalent control group design. Suburban pediatric practice in Pittsburgh, PA (n=240).	Education, physician counseling with the option to purchase smoke detector at office visit (n=120). Control group received usual/routine care (n=120).	Correctly-installed and working smoke detector as determined by home visit.	88.8% consented to home inspection. Moderate baseline use of smoke detectors (42.6% of intervention group vs. 53% of control group). 47.3% of intervention group purchased units vs. none of the controls. Intervention group less likely not to have operational smoke detector (OR=0.75, 0.41-1.4).	Rental units less likely to have smoke detectors than owned housing units (18% vs. 55%). Brief intervention which included offering smoke detectors for sale was successful in this middle class practice setting.
Thomas, 1984	Randomized controlled trial, single blinded. Members of HMO in Kansas City, Kansas who selected 90 min. "well baby" classes. Randomized to experimental (n=29) or control group (n=26); children under 1 year.	Module on burn prevention including coupon for reduced price smoke alarm added to usual well baby class curriculum; home visit after 4-6 weeks for both groups	Scores on Fire Safety Knowledge Test Home tap water temperature Smoke alarm installation	Mean score on Knowledge test 20.3 (experimental group) vs. 18.9 (control group), p=0.0001. 76% of experimental group had safe water temperature vs. 23% of controls; 66% of experimental group lowered temperature setting vs. none of the controls, p=0.01. No significant difference in smoke alarm installation.	Single education session effective. However, the study was small and had the following weaknesses: selection bias-volunteers for classes; population employed, married and in late 20's; post-test measures only for water temperature and smoke detector installation.

Note. The data in Appendix F are from *Fire and Burn Injury Interventions, Interventions to Increase Smoke Detector Use.* [On-Line].
Available: http://weber.u.washington.edu/~hiprc/childinjury/topic/fireburns/use.html
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